

BAKER BOTTS LLPTRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

EXPRESS MAIL LABEL No

EU 206 385 256 US

DATE

March 6, 2002

ATTORNEY'S DOCKET NO.

A35026-PCT-USA

U.S. APPLICATION NO.

10/070772

INTERNATIONAL APPLICATION NO.
PCT/KR00/01258INTERNATIONAL FILING DATE
November 3, 2000PRIORITY DATE CLAIMED
July 6, 2000

TITLE OF INVENTION PROCESS FOR PREPARING THERMOPLASTIC TRANSPARENT RESIN

APPLICANT(S) FOR DO/EO/US Keun Hoon YOO, Jeong Su CHOI, Sung Hee KIM and Chan Hong LEE

Applicant herewith submits to the United States Designated /Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210)
 - a. ☒ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409)
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A FIRST preliminary amendment.
☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:
 - a. ☐ a copy of the International Search Report (PCT/ISA/210)
 - b. ☐ a copy of the International Preliminary Examination Report (PCT/IPEA/409)

PCT Request

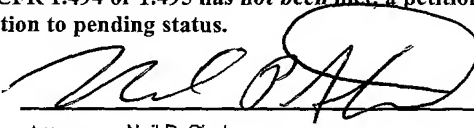
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PCT/IB/306

PCT/IB/308

WO 02/02691 A1 (specification - 24 pages, claims -3 pages, and abstract)

JC10 Rec'd PCT/PTO 06 MAR 2002

INTERNATIONAL APPLICATION NO. PCT/KR00/0258		INTERNATIONAL FILING DATE November 3, 2000		PRIORITY DATE CLAIMED July 6, 2000	
17. <input checked="" type="checkbox"/> The following fees are submitted:				CALCULATIONS <small>PTOUSE ONLY</small>	
Basic National Fee (37 CFR 1.492(a)(1)-(5): Neither international preliminary examination fee (37 CFR 1.482) Nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO (1.492(a)(3)) \$1,040 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO (1.492(a)(5)) \$890.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO (1.492(a)(2)) \$740.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) (1.492(a)(1)) \$710.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00					
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Claims	Number Filed	Number Extra	Rate	\$	
Total Claims	10 -20=	0	X \$ 18.00	\$	0
Independent Claims	1 -3=	0	X \$ 84.00	\$	0
Multiple dependent claim(s) (if applicable)			+ \$280.00	\$	
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Neil P. Sirota BAKER BOTTS L.L.P. 30 Rockefeller Plaza New York, New York 10112-4498			Attorney: Neil P. Sirota PTO Reg: 38,306 March 6, 2002 Date		

10/070772

JC10 Rec'd PCI/PTO 06 MAR 2002

BAKER BOTTS LLP

Attorney Docket Number: A35026-PCT-USA

Title: PROCESS FOR PREPARING THERMOPLASTIC TRANSPARENT RESIN

Use Space Below for Additional Information:

PROCESS FOR PREPARING THERMOPLASTIC TRANSPARENT RESIN**CROSS REFERENCE TO RELATED APPLICATION**

This application is based on application No. 10-2000-0038651 filed
5 in the Korean Industrial Property Office on July 6, 2000, the content of which
is incorporated hereinto by reference.

BACKGROUND OF THE INVENTION**(a) Field of the Invention**

The present invention relates to a process for preparing
10 thermoplastic transparent resin, more particularly to a process for preparing
thermoplastic transparent resin having superior moisture, impact and heat
resistance, natural color, and excellent transparency, which is prepared by
blending graft transparent resin with methylmethacrylate-styrene-acrylonitrile
(hereinafter referred to as "MSAN") copolymer after preparing the former
15 through emulsion polymerization and the latter through bulk polymerization.

(b) Description of the Related Art

Recently, studies for providing materials used with high
functionalities such as transparency, etc. have been strongly and actively
pursued in order to promote differentiation of product models as industries
20 advance, and technology continues to change our lives.

For example, studies for newly providing transparency to materials

such as transparent windows of personnel communication systems, covers of washing machines through which machine contents can be seen, monitor housings through which internal components of computer monitors can be seen, game machine housings, transparent windows of home appliances and office appliances, etc. are intensively being pursued.

However, although acrylonitrile-butadiene-styrene (hereinafter referred to as "ABS") copolymer resin used in these conventional components is superior in terms of qualities such as impact resistance, chemical resistance, processibility, surface glossiness, etc., it is limited in application to materials in which transparency is required since it is an opaque material because of the nature of the resin.

The conventional technologies for providing plastic materials with transparency include 1) a method using transparent polycarbonate resin; 2) a method for providing transparent polymethyl methacrylate (PMMA) resin with impact resistance (United States Patent No. 3,787,522 and Japanese Patent Laid-open Publication No. Showa 63-42940); and 3) a method for providing high impact polystyrene (HIPS) resin with transparency (European Patent No. 703,252A2 and Japanese Patent Laid-open Publication No. Heisei 11-147920).

However, the method 1) has problems of low chemical resistance and impact resistance at a low temperature, and it is short in processibility thereby limiting application with large scale components, although transparency and impact resistance at ordinary temperature are superior.

The method 2) has an extremely lower impact resistance and a lower chemical resistance thus limiting applications, although transparency and processibility are superior. The method 3) has problems in that chemical resistance and scratch resistance are limited.

5 Therefore, suggested in United States Patent No. 4,767,833 is a process for preparing transparent resin having superior impact resistance, chemical resistance, and processibility by graft copolymerizing styrene-butadiene rubber (SBR) latex with monomers such as methylmethacrylate, styrene, acrylonitrile, etc. in order to solve the problems. However, the
10 method does not have good impact resistance at a low temperature, and it is limited in obtaining extremely superior transparent resin.

 Furthermore, there are problems of deteriorated moisture and heat resistance in which products are discolored into a milky white color by hot water, and problems that products are discolored into a yellowish color by
15 the influences of residual emulsifiers and coagulants remaining in the final products when the suggested technologies are applied to a product such as a transparent window of a washing machine, which has a great deal of contact with water.

SUMMARY OF THE INVENTION

20 It is an object of the present invention to prepare a thermoplastic resin having excellent impact resistance, chemical resistance, processibility, superior moisture and heat resistance, natural color, etc., and extremely superior transparency by blending graft transparent resin with MSAN

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copolymer after preparing graft transparent resin. This is done through emulsion polymerization in a manner whereby a refractive index of conjugated diene rubber latex is similar to that of a mixture of methylmethacrylate, styrene, acrylonitrile, etc. which are grafted to the
5 conjugated diene rubber latex, and through preparing MSAN copolymer of which a refractive index is similar to that of graft transparent resin through bulk polymerization, in order to solve problems of the conventional technologies.

In order to accomplish the above object, the present invention
10 provides a process for preparing thermoplastic transparent resin comprising the steps of:

- i) preparing graft transparent resin by grafting a monomer mixture comprising 20 to 50 parts by weight of conjugated diene rubber latex, 10 to 50 parts by weight of methacrylic acid alkylester compound or acrylic acid alkylester compound, 5 to 25 parts by
15 weight of aromatic vinyl compound, and 1 to 10 parts by weight of vinylcyan compound, by emulsion polymerization;
- ii) preparing methylmethacrylate-styrene-acrylonitrile (MSAN) copolymer by copolymerizing 50 to 75 parts by weight of
20 methacrylic acid alkylester compound or alkylester compound, 20 to 45 parts by weight of aromatic vinyl compound, and 1 to 10 parts by weight of vinylcyan compound during bulk polymerization; and

iii) blending the graft transparent resin of step i) with the MSAN copolymer of step ii).

DETAILED DESCRIPTION OF THE INVENTION

In the following detailed description, only the preferred embodiments
5 of the invention have been shown and described, simply by way of
illustration of the best mode contemplated by the inventor(s) of carrying out
the invention. As will be realized, the invention is capable of modification in
various obvious respects, all without departing from the invention.
Accordingly, the description is to be regarded as illustrative in nature, and
10 not restrictive.

The present invention is described in detail as follows.

The proper selection of particle diameter and gel content is important
since particle diameter, gel content, etc. of conjugated diene rubber latex
which is used in preparing graft transparent resin of the present invention
15 greatly influence physical properties such as transparency, impact strength,
etc. of a product.

That is, the smaller the particle diameter of the rubber latex, the
more superior the transparency is, and the greater the deterioration of the
impact strength and fluidity. On the other hand, the larger the particle
20 diameter, the more superior the impact strength is, but the greater the
deterioration of the transparency. Furthermore, if gel content of the rubber
latex is lower, transparency is deteriorated and impact strength is improved

since many monomers are swelled on the rubber latex during the graft reaction, thereby increasing particle diameter. If the gel content is very high, transparency is superior since less monomers are swelled on the rubber latex, while impact resistance deteriorates since impact absorptivity is lowered. Therefore, proper selection of gel content is important.

Furthermore, the selection of emulsifiers is important. The selection of emulsifiers which are relatively stable even with pH variation is important since methylmethacrylate monomer causes severe pH variation due to its characteristics thus significantly dropping stability of latex, and its consumed amount should also be minimized to obtain a transparent resin having superior color, and moisture and heat resistance. Problems have occurred when graft transparent resin has been prepared with the rubber content being low to maintain stability of latex since stability of latex is greatly reduced depending on pH variations, particularly in the preparation process of graft transparent resin having a high rubber content. Furthermore, in order to prepare transparent resin having superior natural color, moisture and heat resistance, etc. by minimizing emulsifiers and coagulants remaining in the final product, the consumed amount of MSAN copolymer prepared through bulk polymerization should be large in a final product so that the consumed amount of graft transparent resin prepared by emulsion polymerization can be minimized.

A process for preparing a thermoplastic transparent resin having superior moisture and heat resistance, natural color, etc. in the present

invention can be divided into 1) a preparation process of graft transparent resin, 2) a preparation process of MSAN copolymer, and 3) a preparation process of a transparent resin having superior moisture and heat resistance, natural color, etc. by blending graft transparent resin and MSAN copolymer.

5 1) Preparation process of graft transparent resin

The present invention provides a process for preparing a thermoplastic resin having superior moisture and heat resistance, natural color, impact resistance, etc., and extremely superior transparency after preparing a graft transparent resin having superior impact resistance through
10 emulsion polymerization by mixing conjugated diene rubber latex having a particle diameter of 2000 to 5000 Å, gel content of 70 to 95%, and a swelling index of 12 to 30 with methacrylic acid alkylester compound, aromatic vinyl compound, vinylcyan compound, etc. so that a refractive index of the mixture can be similar to that of conjugated diene rubber latex,
15 preparing a copolymer of methacrylic acid ester compound, aromatic vinyl compound, and vinylcyan compound which have similar refractive indexes to that of the graft transparent resin through bulk polymerization, and blending the graft transparent resin with the copolymer.

A refractive index of a monomer mixture used absolutely influences
20 transparency, and the refractive index is controlled by the consumed amount and mix ratio of the monomer. That is, the consumed amount and mix ratio of the monomer are very important since the refractive index of polybutadiene is about 1.518, thus refractive indexes of all constituents

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grafted should be adjusted to a value similar to that in order to have superior transparency. Refractive indexes of each constituents used are 1.49 for methylmethacrylate, 1.59 for styrene, and 1.518 for acrylonitrile.

Furthermore, a thermoplastic transparent resin having superior
5 transparency can be prepared when a refractive index of MSAN copolymer which is blended with the graft transparent resin is also adjusted to a value which is similar to that of the graft transparent resin. Methods for adding each monomer constituent to rubber latex when preparing graft transparent resin include a method in which each constituent is input in a batch process,
10 and a method in which the total or partial amount of each monomer constituent is continuously input sequentially. A combined method is used in the present invention in which a batch type and a continuous type of inputting methods are used.

a) Preparation process of rubber latex having small diameter
15 particles

After putting 100 parts by weight of conjugated diene monomer, 1 to 4 parts by weight of emulsifier, 0.1 to 0.6 parts by weight of polymerization initiator, 0.1 to 1.0 part by weight of electrolyte, 0.1 to 0.5 parts by weight of molecular weight controlling agent, and 90 to 130 parts by weight of ion
20 exchange water into a reactor in a batch process, the reaction is carried out at a temperature 50 to 65 °C for 7 to 12 hours. And then, conjugated diene rubber latex having small diameter particles with an average particle diameter of 600 to 1500 Å, gel content of 70 to 95%, and swelling index of

about 12 to 30 is prepared by additionally adding a molecular weight controlling agent at 0.05 to 1.2 parts by weight to the reactant, and reacting the resulting mixture at a temperature of 55 to 70 °C for 5 to 15 hours.

Emulsifiers used in the present invention are one or more emulsifiers
5 selected from the group consisting of alkylaryl sulfonate, alkali methylalkyl sulfate, sulfonated alkylester, soap of fatty acids, alkali salt of abietic acids, and a mixture thereof. A polymerization initiator is water soluble persulfate, peroxy compound, or redox system, and the most preferable water soluble persulfates are sodium and potassium persulfate. Fat soluble
10 polymerization initiators are one or more initiators selected from the group consisting of cumene hydroperoxide, diisopropylbenzene hydroperoxide, azobisisobutyronitrile, tertiary butyl hydroperoxide, paramethane hydroperoxide, benzoyl peroxide, and a mixture thereof.

Electrolytes are one or more electrolytes selected from the group
15 consisting of KCl, NaCl, KHCO_3 , NaHCO_3 , K_2CO_3 , Na_2CO_3 , KHSO_3 , NaHSO_3 , $\text{K}_4\text{P}_2\text{O}_7$, K_3PO_4 , Na_3PO_4 , K_2HPO_4 , Na_2HPO_4 , and a mixture thereof. Mercaptan groups are mainly used as the molecular weight controlling agent.

The polymerization temperature is extremely important in adjusting gel content and swelling index of rubber latex, and selection of an initiator
20 should also be considered at this time.

b) Preparation process of rubber latex having large diameter particles (fusion process of rubber latex having small diameter particles)

Particles were enlarged by agitating the reactant while slowly adding

3.0 to 4.0 parts by weight of acetic acid aqueous solution to 100 parts by weight of rubber latex having small diameter particles of 600 to 1500 Å, gel content of 70 to 95%, and a swelling index of 12 to 30 for 1 hour. After then, rubber latex having large diameter particles of 2000 to 5000 Å, gel content of 70 to 95%, and a swelling index of 12 to 30 was prepared by stopping the agitation. Although a method for obtaining rubber latex which is used to provide for impact resistance can be prepared by a direct polymerization method as disclosed in Japanese Patent Laid-open Publication No. Showa 56-136807, the direct polymerization method takes a lot of reaction time and is limited in obtaining rubber latex having a high gel content. Therefore, preferable is a process in which rubber latex having large diameter particles is prepared by first preparing a high gel content rubber latex having small diameter particles in the above preparation process, and adding acidic materials to the rubber latex so that particles can be enlarged in order to prepare a high gel content rubber latex having large diameter particles within a short time.

c) Grafting process

20 to 50 parts by weight of conjugated diene rubber latex prepared in the above process are graft copolymerized using 10 to 50 parts by weight of methacrylic acid alkylester compound or acrylic acid alkylester compound, 5 to 25 parts by weight of aromatic vinyl compound, 1 to 10 parts by weight of vinylcyan compound, 0.2 to 0.6 parts by weight of emulsifier, 0.2 to 0.6 parts by weight of molecular weight controlling agent, 0.05 to 0.3 parts by weight

of polymerization initiator, etc. Emulsifiers used in the polymerization reaction are one or more salts selected from the group consisting of alkylaryl sulfonate, alkali methylalkyl sulfate, sulfonated alkylester, and a mixture thereof. Tertiary dodecyl mercaptan is mainly used as a molecular weight
5 controlling agent. Redox catalyst which is a mixture of peroxide such as cumene hydroperoxide, diisopropylbenzene hydroperoxide, persulfates, etc., and a reductant such as sodium formaldehyde sulfoxylate, sodium ethylenediamine tetraacetate, primary iron sulfide, dextrose, sodium pyrroline, sodium sulfite, etc. can be used as a polymerization initiator. A
10 polymerization conversion ratio of latex obtained after terminating the polymerization is 98% or more, and powder is obtained by adding antioxidant and stabilizer to the latex thus coagulating into calcium chloride aqueous solution at a temperature of 80 °C or more, dehydrating, and drying the solution. Whether the above prepared graft copolymer is stable or not is
15 determined by measuring a solid coagulating fraction (%) as in the following Formula 1:

Formula 1:

[Formula 1]

Solid coagulating fraction (%) = (weight of coagulum produced in a reaction vat (g) / total weight of rubber and monomer) X 100

20 When the solid coagulating fraction is 0.7% or more, latex stability is significantly dropped, and it is difficult to obtain graft copolymer which is appropriate to the present invention due to a large amount of coagulum. Mixing ratio of monomer in the present invention is very important in order to

obtain a thermoplastic resin having superior transparency, and of which the refractive index is differentiated according to the mixing ratio. That is, since the refractive index of polybutadiene rubber latex is about 1.518, the total refractive index of a compound which is grafted to the polybutadiene rubber latex should also be similar to that value, and the refractive index of the total compound is preferably in the range of 1.513 to 1.521.

2) Preparation process of MSAN copolymers

The preparation process of MSAN copolymers is the bulk polymerization process, wherein the copolymers are prepared by controlling methylmethacrylate monomer, styrene monomer, and acrylonitrile monomer in a proper ratio during the preparation of copolymers through bulk polymerization so that refractive indexes of MSAN copolymers can be similar to the refractive index of graft transparent resin which is blended with these copolymers. 40 to 70 parts by weight of methylmethacrylate, 10 to 30 parts by weight of styrene, and 1 to 10 parts by weight of acrylonitrile as monomers, 26 to 30 parts by weight of toluene as solvent, and ditertiary dodecyl mercaptan as a molecular weight controlling agent are used. The adding amount of the mixed raw material solution is maintained so that average reaction time is 2 hours, and a reaction temperature of 140 to 170 °C is maintained.

The preparation process is a continuous process utilizing a raw material injection pump, a continuous agitating vat, a preheating vat and a volatilizing vat, a polymer transferring pump, and an extruder.

The total refractive index of the copolymer compound should be similar to that of graft transparent resin, and a refractive index of the total compound is preferably in the range of 1.513 to 1.521.

- 3) Preparation process of transparent resin having superior moisture
5 and heat resistance, and natural color

After adding MSAN copolymers prepared in the process 2), and filler, antioxidant, and photostabilizer to the graft transparent resin prepared in process 1) and blending them, transparent resin pellets having superior moisture and heat resistance, natural color, etc. are prepared using an
10 extruding and blending machine at a temperature of 200 to 230 °C. The prepared pellets are again extruded before measuring the physical properties.

The total refractive index of the blended thermoplastic transparent resin is preferably in the range of 1.513 to 1.521.

- 15 Furthermore, moisture and heat resistance is examined by the deviation between Haze before and after the prepared resin is left at a temperature of 70 °C at 90% humidity for 72 hours. The more Haze deviation (Δ Haze), the lower the moisture and heat resistance. Color (value b) is more preferable when it is close to 0 since the closer b is to a
20 value of 0, the closer to natural color the product is, and the higher the value b is, the more yellowish the product is.

The present invention is described more in detail in the following
EXAMPLES, wherein the EXAMPLES are only for exemplifying the present

invention, however the present invention is not limited to the EXAMPLES only.

[EXAMPLES]

Evaluation of major physical properties was performed in

5 EXAMPLES using the following measuring methods:

a) Izod impact strength was measured according to American Society for Testing and Materials (ASTM) standard D 256;

b) Haze (transparency) was measured according to ASTM standard D 1003;

10 c) b value (color difference: Lab system) was measured according to JIS K-7105; and

d) Refractive index was measured according to ASTM standard D 542.

EXAMPLE 1

15 1) Preparation process of graft transparent resin

a) Preparation process of rubber latex having small diameter particles

After putting 110 parts by weight of ion exchange water, 100 parts by weight of 1,3-butadiene as a monomer, 1.2 parts by weight of the emulsifier potassium abietate and 1.5 parts by weight of potassium oleate as an
20 emulsifier, 0.1 part by weight of sodium carbonate (Na_2CO_3) and 0.5 parts by weight of potassium hydrogencarbonate (KHCO_3) as an electrolyte, and 0.3 parts by weight of tertiary dodecyl mercaptan (TDDM) as a molecular weight

controlling agent into a nitrogen substituted polymerization reactor (autoclave) in a batch process and increasing the reaction temperature to 55 °C, the reaction was initiated by adding 0.3 part by weight of potassium persulfate as an initiator to the reactant. After reacting for 10 hours, 0.05
5 parts by weight of tertiary dodecyl mercaptan was again added to the reactant and reacted at a temperature of 65 °C for 8 hours, thereby terminating the reaction. And then, the obtained rubber latex was analyzed in the following analyzing method.

i) gel content and swelling index

10 After coagulating the rubber latex using dilute acid or metallic salt, washing, and drying in a dry oven at 60 °C for 24 hours, a lump of rubber was obtained. After cutting the obtained lump of rubber into small pieces, 1 g of rubber fragment was put into 100 g of toluene and stored in a darkroom at room temperature for 48 hours. And then, the rubber fragment was
15 divided into sol and gel, and gel content and swelling index were measured according to the following Formulae 2 and 3:

[Formula 2]

Gel content (%) = (weight of insoluble gel fragment / weight of sample) X 100

20 [Formula 3]

Swelling index = weight of swelled gel / weight of gel

ii) Particle diameter

Particle diameter was measured with a dynamic laser light scattering

method using 370 HPL of the Nicomp Corporation of the U.S.A. A particle diameter of the obtained rubber latex was about 1000 Å, gel content was 90%, and swelling index was about 18.

- b) Preparation process of rubber latex having large diameter particles (fusion process of rubber latex having small diameter particles)

After putting 100 parts by weight of rubber latex having small diameter particles prepared in the EXAMPLE into a reaction vat, and adjusting reaction speed to 10 rpm and reaction temperature to 30 °C, 3.5 parts by weight of 7% acetic acid aqueous solution were slowly put into the reactant over 1 hour. Rubber latex having large diameter particles was prepared by leaving the mixture alone for 30 minutes after stopping the agitation. The rubber latex having large diameter particles prepared in the fusion process was analyzed. A particle diameter of the obtained rubber latex was about 3000 Å, gel content of which was 90%, and swelling index of which was about 17.

- c) Grafting process

After putting 40 parts by weight of rubber latex prepared by the above preparation process, 0.1 part by weight of emulsifier alkylaryl sulfonate, 13.68 parts by weight of methylmethacrylate, 5.32 parts by weight of styrene, 1 part by weight of acrylonitrile, 0.2 parts by weight of tertiary dodecyl mercaptan, 0.048 parts by weight of sodium pyrophosphate, 0.012 parts by weight of dextrose, 0.001 part by weight of primary iron sulfide, and 0.04 parts by weight of cumene hydroperoxide into a nitrogen substituted

polymerization reactor at a temperature of 50 °C in a batch process, the reactant was reacted while increasing the reaction temperature to 73 °C over 1 hour. After continuously putting a mixed emulsifying solution comprising 70 parts by weight of ion exchange water, 0.2 parts by weight of alkylaryl sulfonate, 27.36 parts by weight of methylmethacrylate, 10.64 parts by weight of styrene, 2 parts by weight of acrylonitrile, 0.25 parts by weight of tertiary dodecyl mercaptan, 0.048 parts by weight of sodium pyrophosphate, 0.012 parts by weight of dextrose, 0.001 part by weight of primary iron sulfide, and 0.10 part by weight of cumene hydroperoxide into the reactant for 3 hours and again increasing the reaction temperature to 76 °C, the resultant reactant was aged for 1 hour before terminating the reaction. The polymerization conversion ratio was 99.5%, and the solid coagulated fraction was 0.1%. Thereafter, the latex was coagulated with calcium chloride aqueous solution and washed, thereby obtaining powder.

2) Preparation process of MSAN copolymer

A reaction temperature of 157 °C was maintained while continuously putting a raw material in which 68.4 parts by weight of methylmethacrylate, 26.6 parts by weight of styrene, 5 parts by weight of acrylonitrile, 30 parts by weight of solvent toluene, and 0.15 parts by weight of molecular weight controlling agent ditertiary dodecyl mercaptan were mixed into a reaction vat so that average reaction time could be 2 hours. After heating the polymerized solution discharged from a reaction vat at a preheating vat and volatilizing unreacted monomer from a volatilizing vat, a polymer temperature

of 210 °C was maintained so that copolymer resin was processed into a pellet form using a transferring pump and an extruder.

3) Preparation process of transparent resin having superior moisture and heat resistance and natural color.

5 After preparing pellets using a biaxial extruder at a temperature of 210 °C by putting 0.2 parts by weight of filler, 0.1 part by weight of antioxidant, and 0.1 part by weight of photostabilizer into 45 parts by weight of graft transparent resin prepared by the process 1) and 55 parts by weight of MSAN copolymer prepared by the process 2) and blending them, the
10 pellets were again extruded to prepare transparent resin of which physical properties were measured. Color, moisture and heat resistance, and initial transparency of the resin samples were superior, wherein impact strength was 16, color (value b) was 0.0, initial Haze was 2.3, and Haze deviation after the moisture and heat resistance test was about 5.

15 COMPARATIVE EXAMPLE 1

A transparent resin was prepared in the same method as in the EXAMPLE 1 except that 16 parts by weight of methylmethacrylate, 3 parts by weight of styrene and 1 part by weight of acrylonitrile instead of 13.68 parts by weight of methylmethacrylate, 5.32 parts by weight of styrene, and 1
20 part by weight of acrylonitrile used in the initial stage of c) grafting process of 1) were used, and 31 parts by weight of methylmethacrylate, 7 parts by weight of styrene, and 2 parts by weight of acrylonitrile instead of 27.36 parts by weight of methylmethacrylate, 10.64 parts by weight of styrene, and 2

parts by weight of acrylonitrile used in the later stage of c) grafting process of 1) were used, and its physical properties were measured. Color, and moisture and heat resistance were superior but initial Haze (transparency) was not good in the transparent resin samples, wherein impact strength was 16.5, color (value b) was 0.15, initial Haze was 9.8, and Haze deviation after the moisture and heat resistance test was about 5. The initial transparency deteriorated due to the refractive index difference between graft transparent resin and MSAN.

COMPARATIVE EXAMPLE 2

A transparent resin was prepared in the same method as in the EXAMPLE 1 except that 12 parts by weight of methylmethacrylate, 7 parts by weight of styrene and 1 part by weight of acrylonitrile instead of 13.68 parts by weight of methylmethacrylate, 5.32 parts by weight of styrene, and 1 part by weight of acrylonitrile used in the initial stage of c) grafting process of 1) were used, and 25 parts by weight of methylmethacrylate, 13 parts by weight of styrene, and 2 parts by weight of acrylonitrile instead of 27.36 parts by weight of methylmethacrylate, 10.64 parts by weight of styrene, and 2 parts by weight of acrylonitrile used in the later stage of c) grafting process of 1) were used, and its physical properties were measured. Color, and moisture and heat resistance were superior while initial Haze (transparency) was not good in the transparent resin samples, wherein impact strength was 15.5, color (value b) was 0.1, initial Haze was 9.3, and Haze deviation after the moisture and heat resistance test was about 4. The initial transparency

(Haze) deteriorated due to the refractive index difference between graft transparent resin and MSAN.

COMPARATIVE EXAMPLE 3

A transparent resin was prepared in the same method as in the
5 EXAMPLE 1 except that 76 parts by weight of methylmethacrylate, 19 parts
by weight of styrene and 5 parts by weight of acrylonitrile instead of 68.4
parts by weight of methylmethacrylate, 26.6 parts by weight of styrene, and 5
parts by weight of acrylonitrile used in the 2) preparation process of MSAN
copolymer were used, and its physical properties were measured. Color,
10 and moisture and heat resistance were superior while initial Haze
(transparency) was not good in the transparent resin samples, wherein
impact strength was 16, color (value b) was 0.15, initial Haze was 9.4, and
Haze deviation after the moisture and heat resistance test was about 5.
The initial transparency (Haze) deteriorated due to the refractive index
15 difference between graft transparent resin and MSAN.

COMPARATIVE EXAMPLE 4

A transparent resin was prepared in the same method as in the
EXAMPLE 1 except that 64 parts by weight of methylmethacrylate, 31 parts
by weight of styrene and 5 parts by weight of acrylonitrile instead of 68.4
20 parts by weight of methylmethacrylate, 26.6 parts by weight of styrene, and 5
parts by weight of acrylonitrile used in the 2) preparation process of MSAN
copolymer were used, and its physical properties were measured. Color,
and moisture and heat resistance were superior while initial Haze

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(transparency) was not good in the transparent resin samples, wherein impact strength was 15.5, color (value b) was 0.1, initial Haze was 9.9, and Haze deviation after the moisture and heat resistance test was about 5. The initial transparency (Haze) deteriorated due to the refractive index difference between graft transparent resin and MSAN.

COMPARATIVE EXAMPLE 5

A transparent resin was prepared in the same method as in the EXAMPLE 1 except that 0.1 part by weight of potassium oleate instead of 0.1 part by weight of emulsifier alkylaryl sulfonate used in the initial stage of c) grafting process of 1) were used. As a result of polymerization, lots of solid coagulum was produced due to the deterioration of latex stability, thereby the result of this method does not fit to the object of the present invention.

COMPARATIVE EXAMPLE 6

A transparent resin was prepared in the same method as in the EXAMPLE 1 except that 0.3 parts by weight of potassium oleate instead of 0.1 part by weight of emulsifier alkylaryl sulfonate used in the initial stage of c) grafting process of 1) were used, and its physical properties were measured. Color was not good, and moisture and heat resistance were also sub-standard in the transparent resin samples, wherein impact strength was 16, color (value b) was 2.8, initial Haze was 4.5, and Haze deviation after the moisture and heat resistance test was about 17.

COMPARATIVE EXAMPLE 7

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A transparent resin was prepared in the same method as in the EXAMPLE 1 except the following.

After putting 18 parts by weight of rubber latex, 90 parts by weight of ion exchange water, 0.1 part by weight of emulsifier alkylaryl sulfonate, 13.68 parts by weight of methylmethacrylate, 5.32 parts by weight of styrene, 1 part by weight of acrylonitrile, 0.2 parts by weight of tertiary dodecyl mercaptan, 0.048 parts by weight of sodium pyrophosphate, 0.012 parts by weight of dextrose, 0.001 part by weight of primary iron sulfide, and 0.04 parts by weight of cumene hydroperoxide into a reactor at a temperature of 50 °C in a batch process, the reaction was performed while increasing the reaction temperature to 73 °C over 1 hour. After continuously adding a mixed emulsifying solution comprising 70 parts by weight of ion exchange water, 0.2 parts by weight of alkylaryl sulfonate, 43.2 parts by weight of methylmethacrylate, 16.8 parts by weight of styrene, 2 parts by weight of acrylonitrile, 0.25 parts by weight of tertiary dodecyl mercaptan, 0.048 parts by weight of sodium pyrophosphate, 0.012 parts by weight of dextrose, 0.001 part by weight of primary iron sulfide, and 0.10 part by weight of cumene hydroperoxide into the reactant over 3 hours and again increasing the reaction temperature to 76 °C, the resulting reactant was aged for 1 hour, thereby terminating the reaction. The polymerization conversion ratio was 99.8%, and the solid coagulated fraction was 0.05%. Thereafter, the latex was coagulated with calcium chloride aqueous solution and washed, thereby obtaining powder.

Furthermore, after preparing pellets using a biaxial extruder at a temperature of 210 °C by putting 0.2 parts by weight of filler, 0.1 part by weight of antioxidant, and 0.1 part by weight of photostabilizer into 100 parts by weight of powder obtained in the 1) preparation process of graft
5 transparent resin without a preparation process of MSAN copolymer and blending them, the pellets were again extruded to prepare transparent resin of which physical properties were measured. Color was not good, and moisture and heat resistance, etc. were also deteriorated in the transparent resin samples, wherein impact strength was 16.5, color (value b) was 3.2,
10 initial Haze was 4.9, Haze deviation after the moisture and heat resistance test was about 12.

A preparation process of thermoplastic transparent resin according to the present invention can prepare a thermoplastic transparent resin having excellent impact resistance, chemical resistance, processibility, etc., superior
15 moisture and heat resistance, natural color, etc., and extremely superior transparency after preparing a graft transparent resin having superior impact resistance, transparency, etc. through emulsion polymerization by employing methylmethacrylate and controlling contents and mixing ratios of each constituent employed so that the refractive index of conjugated diene rubber
20 latex can be similar to that of a mixture of methylmethacrylate, styrene, acrylonitrile, etc. which are grafted to the conjugated diene rubber latex in preparing acrylonitrile-butadiene-styrene (ABS) resin comprising acrylonitrile providing superior chemical resistance, butadiene providing superior impact

24

resistance, and styrene providing superior processibility, preparing an MSAN copolymer of which the refractive index is similar to that of graft transparent resin in the emulsion polymerization process, and blending the graft transparent resin with the MSAN copolymer.

5 While the present invention has been described in detail with reference to the preferred embodiments, those skilled in the art will appreciate that various modifications and substitutions can be made thereto without departing from the spirit and scope of the present invention as set forth in the appended claims.

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WHAT IS CLAIMED IS:

1. A process for preparing thermoplastic transparent resin comprising

the steps of:

5 i) preparing graft transparent resin by grafting a monomer mixture comprising 20 to 50 parts by weight of conjugated diene rubber latex, 10 to 50 parts by weight of methacrylic acid alkylester compound or acrylic acid alkylester compound, 5 to 25 parts by weight of aromatic vinyl compound, and 1 to 10 parts by weight of vinylcyan compound
10 through emulsion polymerization;

ii) preparing methylmethacrylate-styrene-acrylonitrile (MSAN) copolymer by copolymerizing 50 to 75 parts by weight of methacrylic acid alkylester compound or alkylester compound, 20 to 45 parts by weight of aromatic vinyl compound, and 1 to 10 parts by weight of vinylcyan compound during bulk polymerization; and

15 iii) blending the graft transparent resin of step i) with the MSAN copolymer of step ii).

2. The process for preparing thermoplastic transparent resin according to claim 1, wherein a difference of refractive index between the conjugated diene rubber latex and monomer mixture grafted is within the range of 0.004.

3. The process for preparing thermoplastic transparent resin according to claim 1, wherein a difference of refractive index between the

conjugated diene rubber latex and MSAN copolymer is within the range of 0.004.

4. The process for preparing thermoplastic transparent resin according to claim 1, wherein the conjugated diene rubber latex is an
5 aliphatic conjugated diene compound, or a mixture of an aliphatic conjugated diene compound and an ethylene based unsaturated monomer.

5. The process for preparing thermoplastic transparent resin according to claim 1, wherein the conjugated diene rubber latex has an average particle diameter of 2000 to 5000 Å, a gel content of 70 to 95%,
10 and a swelling index of 12 to 30.

6. The process for preparing thermoplastic transparent resin according to claim 1, wherein the methacrylic acid alkylester compound or acrylic acid alkylester compound is methylmethacrylate.

7. The process for preparing thermoplastic transparent resin
15 according to claim 1, wherein the aromatic vinyl compound is a compound selected from the group consisting of styrene, α -methylstyrene, o-ethylstyrene, p-ethylstyrene, and vinyltoluene.

8. The process for preparing thermoplastic transparent resin according to claim 1, wherein the vinylcyan compound is a compound
20 selected from the group consisting of acrylonitrile, methacrylonitrile, and ethacrylonitrile.

9. The process for preparing thermoplastic transparent resin according to claim 1, wherein the emulsion polymerization of step i) is

carried out using a mixture of one or more emulsifiers selected from the group consisting of alkylaryl sulfonate salts, alkali methylalkyl sulfate salts, and sulfonated alkylester salts.

10. The process for preparing thermoplastic transparent resin
5 according to claim 1, wherein the emulsion polymerization of step i) and bulk polymerization of step ii) are carried out using one or more polymerization initiators selected from the group consisting of cumene hydroperoxide, diisopropylbenzene hydroperoxide, and persulfate.

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10070772-030502

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
10 January 2002 (10.01.2002)

PCT

(10) International Publication Number
WO 02/02691 A1

(51) International Patent Classification⁷: **C08L 51/04**,
53/02

(21) International Application Number: PCT/KR00/01258

(22) International Filing Date:
3 November 2000 (03.11.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2000/38651 6 July 2000 (06.07.2000) KR

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(81) Designated States (*national*): CN, DE, JP, US.

(84) Designated State (*regional*): European patent (FR).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: PROCESS FOR PREPARING THERMOPLASTIC TRANSPARENT RESIN

(57) Abstract: The present invention relates to a process for preparing thermoplastic transparent resin, and provides a process for preparing thermoplastic transparent resin comprising the steps of: (Y) preparing graft transparent resin by grafting a monomer mixture comprising 20 to 50 parts by weight of conjugated diene rubber latex, 10 to 50 parts by weight of methacrylic acid alkylester compound or acrylic acid alkylester compound, 5 to 25 parts by weight of aromatic vinyl compound, and 1 to 10 parts by weight of vinylcyan compound through emulsion polymerization; (Y₂) preparing methylmethacrylate-styrene-acrylonitrile (hereinafter referred to as "MSAN") copolymer by copolymerizing 50 to 75 parts by weight of methacrylic acid alkylester compound or alkylester compound, 20 to 45 parts by weight of aromatic vinyl compound, and 1 to 10 parts by weight of vinylcyan compound during bulk polymerization; and (Y) blending the graft transparent resin of step (Y) with the MSAN copolymer of step (Y₂). The thermoplastic transparent resin prepared by the present invention is good in terms of impact resistance, chemical resistance, processibility, etc., has superior moisture and heat resistance, natural color, etc., and extremely superior transparency.

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COMBINED DECLARATION AND POWER OF ATTORNEY

(Original, Design, National Stage of PCT, Divisional, Continuation or C-1-P Application)

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is

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This declaration is of the following type:

- ☐ original
- ☐ design
- ☒ national stage of PCT.
- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (C-I-P)

the specification of which: (complete (a), (b), or (c))

- (a) ☐ is attached hereto.
- (b) ☐ was filed on as Application Serial No. _____ and was amended on (if applicable).
- (c) ☒ was described and claimed in PCT International Application No. PCT/KR00/01258 filed on November 3, 2000 and was amended on (if applicable).

Acknowledgement of Review of Papers and Duty of Candor

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the subject matter claimed in this application in accordance with Title 37, Code of Federal Regulations § 1.56.

In compliance with this duty there is attached an information disclosure statement. 37 CFR 1.98.

Priority Claim

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventors certificate or of any PCT International Application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign applications) for patent or inventor's certificate or any PCT International Application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application on which priority is claimed

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- (d) ☐ no such applications have been filed.
- (e) ☒ such applications have been filed as follows:

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PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION			
COUNTRY	APPLICATION NO.	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)
Korea	Pat. 2000-38651	06/07/2000	
			PRIORITY CLAIMED UNDER 35 USC 119
			<input checked="" type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
ALL FOREIGN APPLICATION(S), IF ANY, FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION			
			<input type="checkbox"/> YES NO <input type="checkbox"/>
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Claim for Benefit of Prior U.S. Provisional Application(s)

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PCT/KR00/01258	November 3, 2000	Pending
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

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FILE NO.:

37 CFR 1.47.

Number of pages added _____

2002/02/25 19:06:18